

REMARKS

The Applicants sincerely appreciate the thorough examination of the present application as evidenced by the Office Action of December 29, 2009 (the Office Action). By this Amendment, the Applicants have: amended Claims 1-6, 8-16, 21-22, 24, and 26-31 to provide clarification thereof; amended Claim 21 to depend from Claim 2; and added new Claims 56-62. In addition, the Applicants have amended Figure 2 and related portions of the specification to provide illustration of a controller. The Applicants have also canceled withdrawn Claims 32-55 to reduce issues for further consideration.

In the following remarks, the Applicants will show that all claims are patentable over the cited art. Accordingly, the Applicants submit that the present Application is in condition for allowance, and a Notice of Allowance is respectfully requested in due course.

All Objections To The Drawings Have Been Overcome

The Office Action has objected to the drawings, stating that the controller (as recited in Claim 19) and the split header (as recited in Claim 22) must be shown in the drawings. Office Action, page 2. Regarding Claim 19, the Applicants have amended Figure 2 and the paragraph beginning on page 5, line 29 and ending on page 6, line 4 of the originally filed application so that the controller is clearly shown. (This paragraph is presented as paragraph [0025] on page 2 of the corresponding U.S. patent publication (i.e., 2006/0225773).) Regarding Claim 22, the Applicants have amended Claim 22 to recite a "split stage" as set forth in paragraph [0039] with respect to Figure 5 of the originally filed specification. Accordingly, the Applicants submit that all objections to the drawings have been overcome.

All Rejections Under 35 U.S.C. Sec. 112 Have Been Overcome

The Office Action rejected Claim 21 under 35 U.S.C. Sec. 112, second paragraph, stating that there is insufficient basis for the recitation "said temperature differential" in line 2. Office Action, page 3. To reduce issues for further consideration, the Applicants have amended Claim 21 to depend from Claim 2, and Claim 2 recites "... to establish a temperature differential...." Accordingly, dependent Claim 2 provides antecedent basis for

the recitation "said temperature differential" in dependent Claim 21, and all rejections under 35 U.S.C. Sec. 112 have thus been overcome.

Claim 1 Is Patentable

The Office Action rejected Claim 1 under 35 U.S.C. Sec. 102(b) as being anticipated by U.S. Patent No. 6,300,150 to Venkatasubramanian et al. (Venkatasubramanian). The Applicants respectfully submit, however, that Claim 1 is patentable over Venkatasubramanian for at least the reasons discussed below. In particular, Claim 1 recites a thermoelectric device comprising:

at least one unipolar couple element having first and second legs of a same electrical conductivity type;
a first-temperature stage connected to the first leg;
a second-temperature stage connected across the first and second legs of the at least one unipolar couple element; and
a third-temperature stage connected to the second leg, wherein the first leg is between the first-temperature stage and the second-temperature stage, and wherein the second leg is between the second-temperature stage and the third temperature stage.
(Underline added.)

Under 35 U.S.C. § 102, "a claim is anticipated **only if each and every element as set forth in the claim is found**, either expressly or inherently described, in a single prior art reference." M.P.E.P. § 2131 (quoting *Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987)). "Anticipation under 35 U.S.C. § 102 requires the disclosure in a single piece of prior art **of each and every limitation** of a claimed invention." *Apple Computer Inc. v. Articulate Sys. Inc.*, 57 U.S.P.Q.2d 1057, 1061 (Fed. Cir. 2000). A finding of anticipation further requires that **there must be no difference between the claimed invention and the disclosure of the cited reference** as viewed by one of ordinary skill in the art. See *Scripps Clinic & Research Foundation v. Genentech Inc.*, 927 F.2d 1565, 1576, 18 U.S.P.Q.2d 1001, 1010 (Fed. Cir. 1991). In particular, the Court of Appeals for the Federal Circuit held that a finding of anticipation requires absolute identity for each and every element set forth in the claimed invention. See *Trintec Indus. Inc. v. Top-U.S.A. Corp.*, 63 U.S.P.Q.2d 1597 (Fed. Cir. 2002). More recently, the Court of Appeals for the Federal

Circuit held that:

unless a reference discloses within the four corners of the document not only all of the limitations claimed but also all of the limitations arranged or combined in the same way as recited in the claim, it cannot be said to prove prior invention of the thing claimed and, thus, cannot anticipate under 35 U.S.C. Sec. 102.

Net Moneyin, Inc. v. Verisign, Inc., slip opinion, pages 17-18, (Fed. Cir., Oct. 20, 2008). The Applicants respectfully submit that Venkatasubramanian does not anticipate Claim 1 because Venkatasubramanian does not disclose or suggest:

- (1) a unipolar couple element having first and second legs of a same electrical conductivity type; and/or
- (2) first, second, and third temperature stages connected to/across legs of a unipolar couple element.

In support of the rejection of Claim 1, the Office Action states that

Venkatasubramanian discloses:

a thermoelectric device (see figs. 6 and 9) comprising: at least one unipolar couple element having two legs of a same electrical conductivity type (two P-type semiconductor legs as shown in fig. 9 ...); a first temperature stage connected to one of said two legs; a second-temperature stage connected across said legs of the at least one unipolar couple element; and a third-temperature stage connected to the other of said two legs (see 2:55-5:32)....

Office Action, pages 3-4.

Regarding a unipolar couple element, the Office Action seems to take the position that a pair of adjacent p-type elements from the right side Figure 9 of Venkatasubramanian define a unipolar couple as recited in Claim 1. The metallization patterns shown in Venkatasubramanian's Figures 4 and 8 for the bottom and top headers of the thermoelectric device of Venkatasubramanian's Figure 9, however, show that every other one of the p-type elements along the right edge of the structure of Figure 9 is not utilized. Stated in other words, in each case where two adjacent p-type elements are coupled by an electrical short (indicated by an "x") as shown in Figures 8 and 9, one of the two adjacent p-type elements is not used for current transport as shown by the unconnected pads along the right side of Figure 4. As discussed in Venkatasubramanian with respect to Figures 4 and 9 thereof:

Electrical shorts between pads are indicated by an "x" in the metallized header/heat-sink. These shorts serve to keep the current flow from the top of the n-type element to the bottom of the n-type element, and similarly from the bottom of the p-type element to the top of the [p-type] element. ...

For this 8x9 matrix of thermoelements, four each of the n- and p-type elements (identified by "y") do not participate in the current transport through the thickness of the film. They only serve to provide the electrical connection and uniform mechanical strength in the arrangement of the thermoelements. (Underline added.)

Venkatasubramanian, col. 4, lines 50-67. Venkatasubramanian thus discloses a structure where current flow in all of the utilized n-type elements is in a first direction (i.e., from top to bottom) and where current flows in all of the utilized p-type elements is in a second direction (i.e., from bottom to top). Where two adjacent p-type elements are connected by an electrical short on the heat-sink side, one of the p-type elements does "not participate in the current transport through the thickness of the film." Venkatasubramanian, col. 4, lines 63-65.

Accordingly, Venkatasubramanian does not disclose or suggest at least one unipolar couple element having two legs of a same electrical conductivity type.

Regarding first-, second-, and third- temperature stages, the Office Action seems to take the position that Venkatasubramanian's two heat-spreading headers (one on the heat-sink side and one on the source side) somehow define three different temperature stages. As shown in Figure 9 of Venkatasubramanian, however, "all of the thermoelements are thermally in parallel (between the heat-sink and heat-source)...." Venkatasubramanian, col. 4, lines 59-60. Accordingly, Venkatasubramanian fails to disclose or suggest first, second, and third temperature stages connected to/across legs of a unipolar couple element as recited in Claim 1.

Because Venkatasubramanian fails to disclose or suggest multiple elements of Claim 1 as discussed above, the Applicants respectfully submit that Claim 1 is patentable. In addition, the Applicants submit that dependent Claims 2-31 and 56-61 are patentable at least as per the patentability of Claim 1 from which they depend.

Dependent Claim 2 Is Separately Patentable

The Office Action rejected Claim 2 under 35 U.S.C. Sec. 102(b) as being anticipated by Venkatasubramanian. Claim 2, however, is patentable at least as per the patentability of Claim 1 from which it depends. Claim 2 is also separately patentable for at least the additional reasons discussed below.

Claim 2 depends from Claim 1 and thus includes all recitations discussed above with respect to Claim 1. In addition, Claim 2 recites

wherein said at least one unipolar couple element is configured such that currents flow in opposite directions in the first and second legs of the same electrical conductivity type of the at least one unipolar couple element to establish a temperature differential across each of the first and second legs of said unipolar couple element. (Underline added.)

Regarding Claim 2, the Office Action states that:

Venkatasubramanian further discloses the thermoelectric devices allows for high cooling (col. 1, lines 40-53), and therefore the TE device must inherently functions in Peltier mode. It is well known in the thermoelectric art that in Peltier mode operation, the thermoelectric elements are configured such that currents flow in opposite directions in the two legs of the at least one unipolar couple element to establish a temperature differential across each of the two legs of said unipolar couple element.

Office Action, page 4.

As discussed above with respect to Claim 1, Venkatasubramanian discusses an arrangement of p-type and n-type thermoelectric elements and metallization patterns (including shorts) that serves "to keep the current flow from the top of the n-type element to the bottom of the n-type element, and similarly from the bottom of the p-type element to the top of the [p-type] element." Venkatasubramanian, col. 4, lines 51-54. Where two adjacent p-type elements are coupled through electrical shorts (indicated by an "x" in Figure 8 of Venkatasubramanian), one of the two adjacent p-type elements does "not participate in the current transport through the thickness of the film." Venkatasubramanian, col. 4, lines 63-65. Accordingly, Venkatasubramanian does not disclose or suggest currents flowing in opposite directions in first and second legs of a same electrical conductivity type of a unipolar couple element as recited in Claim 2.

For at least the reasons discussed above, Claim 2 is separately patentable over Venkatasubramanian.

Dependent Claim 17 Is Separately Patentable

The Office Action rejected Claim 17 under 35 U.S.C. Sec. 103(a) as being unpatentable over Venkatasubramanian in view of U.S. Patent No. 5,837,929 to Adelman (Adelman). Claim 17, however, is patentable at least as per the patentability of Claim 1 from which it depends. Claim 17 is also separately patentable for at least the additional reasons discussed below.

Claim 17 depends from Claim 1 and thus includes all recitations discussed above with respect to Claim 1. In addition, Claim 17 recites:

a thermal insulation between said first-temperature stage and said third-temperature stage wherein the first and second legs of the same electrical conductivity type and the first-temperature stage and the third-temperature stage are on a same side of the second-temperature stage.

Regarding Claim 17, the Office Action states that:

The reference [Venkatasubramanian] is silent as to a thermal insulation between the first and third temperature stages.

Adelman discloses a thermoelectric cooler (2:17-21) wherein a thermal insulation (15) of a polymer sheets (polyimide) (3:50-54) is provided between the temperature stages (16s) (see fig. 3) in order to provide heat insulation between the thermoelements (4:17-18).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the thermal insulation layer of Adelman in the thermoelectric device of Venkatasubramanian in order to provide heat insulation between the thermoelements as shown by Adelman.

Office Action, page 10. As shown in Figure 3 of Adelman, however, Adelman discusses alternating P-type and N-type elements between two ceramic plates 18. Accordingly, Adelman and Venkatasubramanian (taken alone or in combination) both fail to disclose a structure including a unipolar couple (having two legs of a same electrical conductivity) and/or first-, second-, and third- temperature stages. More particularly, the combination of Venkatasubramanian fails to disclose or suggest first and third temperatures stages (on a same

side of a second temperature stage) with thermal insulation therebetween.

Accordingly, the Applicants submit that Claim 17 is separately patentable.

Dependent Claims 26 And 29 Are Separately Patentable

The Office Action rejected Claims 26 and 29 under 35 U.S.C. Sec. 103(a) as being unpatentable over Venkatasubramanian in view of U.S. Publication No. 2002/0092557 to Ghoshal (Ghoshal). Claims 26 and 29, however, are patentable at least as per the patentability of Claim 1 from which they depend. Claims 26 and 29 are also separately patentable for at least the additional reasons discussed below.

Claim 26, for example, depends from Claim 1 and thus includes all recitations discussed above with respect to Claim 1. In addition, Claim 26 recites:

wherein the first and second legs of the at least one unipolar couple element comprise respective first and second p-type thermoelements with the first and second p-type thermoelements having at least one of different material compositions and different structures.

Regarding Claim 26, the Office Action states that: "Venkatasubramanian in view of Ghoshal discloses that each of the legs of the p-p couple comprises different material composition and a different structure from the other leg (see [0039] of Ghoshal)." Office Action, page 8. The cited portions of Ghoshal, however, disclose one superlattice structure for a p-type thermoelement and a second superlattice structure for an n-type thermoelement, but not different structures for thermoelements of a same conductivity type. In particular, cited portions of Ghoshal state that:

superlattice thermoelement 212 comprises alternating layers of p-type bismuth chalcogenide materials such as, for example, alternating layers of Bi₂Te₃/Sb₂Te₃ with layers of Bi_{0.5}Sb_{1.5}Te₃, and the superlattice of thermoelement 210 comprises alternating layers of n-type bismuth chalcogenide materials, such as, for example, alternating layers of Bi₂Te₃ with layers of Bi₂Se₃.

Ghoshal, paragraph [0039], page 3. Ghoshal's different structures for p-type and n-type thermoelements 212 and 210, thus fails to disclose or suggest different material compositions and/or different structures for thermoelements having a same conductivity type.

Accordingly, Claim 26 is separately patentable over the cited art. Moreover, Claim 29 is separately patentable for reasons similar to those discussed above with respect to Claim 26.

New Dependent Claim 56 Is Separately Patentable

Claim 56 depends from Claim 1, and Claim 56 further recites that "the at least one unipolar couple element is configured such that currents flow in opposite directions in the two legs of the same electrical conductivity type of the at least one unipolar couple element." Claim 56, however, is patentable for reasons similar to those discussed above with respect to Claim 2. In particular, the cited art fails to disclose or suggest current flowing in opposite directions in two legs of a same electrical conductivity type. As noted above with respect to Claim 2, where two adjacent p-type elements are coupled through electrical shorts (indicated by an "x" in Figure 8 of Venkatasubramanian), one of the two adjacent p-type elements does "not participate in the current transport through the thickness of the film." Venkatasubramanian, col. 4, lines 63-65. Accordingly, Claim 56 is separately patentable.

New Dependent Claim 57 Is Separately Patentable


Claim 57 depends from Claim 1, and Claim 57 further recites "wherein the first and second legs of the same electrical conductivity type and the first-temperature stage and the third-temperature stage are on a same side of the second-temperature stage, and wherein the first-temperature stage and the third temperature stage are spaced apart. " Claim 57 is patentable for reasons similar to those discussed above with respect to Claim 17. In particular, the cited art fails to disclose or suggest three different temperature stages, much less first and third temperature stages (on a same side of a second temperature stage) wherein the first and third temperature stages are spaced apart. Venkatasubramanian and Adelman both disclose only two headers/plates (i.e., headers 30 and 90 in Figure 9 of Venkatasubramanian, and ceramic plates 18 in Figure 3 of Adelman). Accordingly, Claim 57 is separately patentable.

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CONCLUSION

Accordingly, the Applicants submit that all pending claims in the present application are in condition for allowance, and a Notice of Allowance is respectfully requested in due course. The Examiner is encouraged to contact the undersigned attorney by telephone should any additional issues need to be addressed.

Respectfully submitted,


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